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# The ornithophilous tree species, *Butea monosperma* (Lam.) Taub. (Fabaceae: Faboideae), an important nectar source for birds during dry season

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## ABSTRACT

*Butea monosperma* is a hermaphroditic tree species which flowers during dry season without foliage. The flowers are large, orange-red and quite visible from a far way place. The floral traits such as flower-opening during morning time, robust, odorless flowers, deep seated, concealed nectar and ovary, production of ample volume of nectar and the placement of stamens and stigma far away from the nectar location characterize ornithophilous pollination syndrome. Accordingly, the flowers were exclusively foraged by birds of which only passerines are pollinators while the non-passerine birds are nectar-robbers. This tree is an important source of nectar during dry season when there is a dearth of floral nectar. Therefore, *B. monosperma* is in a way a key nectar supplier for birds.

**Keywords:** *Butea monosperma*, ornithophily, dry season.

## 1. INTRODUCTION

The genus *Butea* comprises of two species, *B. superba* and *B. monosperma* which are mainly distributed in dry habitats of Southeast Asia (Sanjappa 1987). It is named after a patron of botany, John Stuart, 3rd Earl of Bute. Solomon Raju and Purnachandra Rao (2007) reported that *B. superba* is a dry season blooming hermaphroditic woody climber. It is ornithophilous and typically pollinated by passerine birds (Rao, 2020). But, non-passerine birds, a squirrel and monkeys also utilize the flowers as a source of nectar without any pollination role. Anonymous (1988) reported that *B. monosperma* is a medium-sized tree which is highly valued as a source of several non-timber forest products. It is largely propagated by seeds but natural fruit set is very low and each fruit bears only one seed which refers to specific epithet. Tandon et al. (2003) reported that *Butea monosperma* is visited by *Nectarinia asiatica*, *Zosterops palpebrosa*, *Pycnonotus cafer*, *Dendrocitta vagabunda*, *Turdoides striatus*, *Corvus splendens* and *Psittacula krameri*. Of these, *N. asiatica* is the only legitimate

nectar forager while *Z. palpebrosa* and *P. cafer* consume nectar by making a hole in the calyx. *P. krameri* removes pistils from young flower buds while all other birds perch upon landing on flowering branches but do not visit the flowers for nectar collection. These authors also reported that the squirrel, *Funambulus tristriatus* collects nectar legitimately from the flowers. With this backdrop, the present study was contemplated to report on the importance of *B. monosperma* as chief nectar source for birds during dry season and also the role of birds in the pollination of this tree.

## 2. MATERIALS AND METHODS

Trees of *Butea monosperma* growing at Kokkanti Cross in Anantapur District and Vaayalpaad in Chittoor District, Andhra Pradesh, were selected for the study during March-May 2021. The trees were tracked for the flowering season first and once the trees began to initiate the floral buds, they were continually followed until flowering season ended. Twenty flowers from five trees were collected to record floral details. The nectar volume was measured using a micropipette and sugar concentration with a hand-held refractometer. Field observations were made from morning to evening on the foragers visiting the flowers. The foragers included only birds despite the presence of insects in the neighbourhood. The birds visiting the flowers were identified and the probing behaviour of individual bird species was recorded to evaluate their nectar-feeding behaviour and their role in effecting pollination or simply as nectar robbers. Based on field observations, the role birds as pollinators was analyzed, described and interpreted in the light of relevant literature.



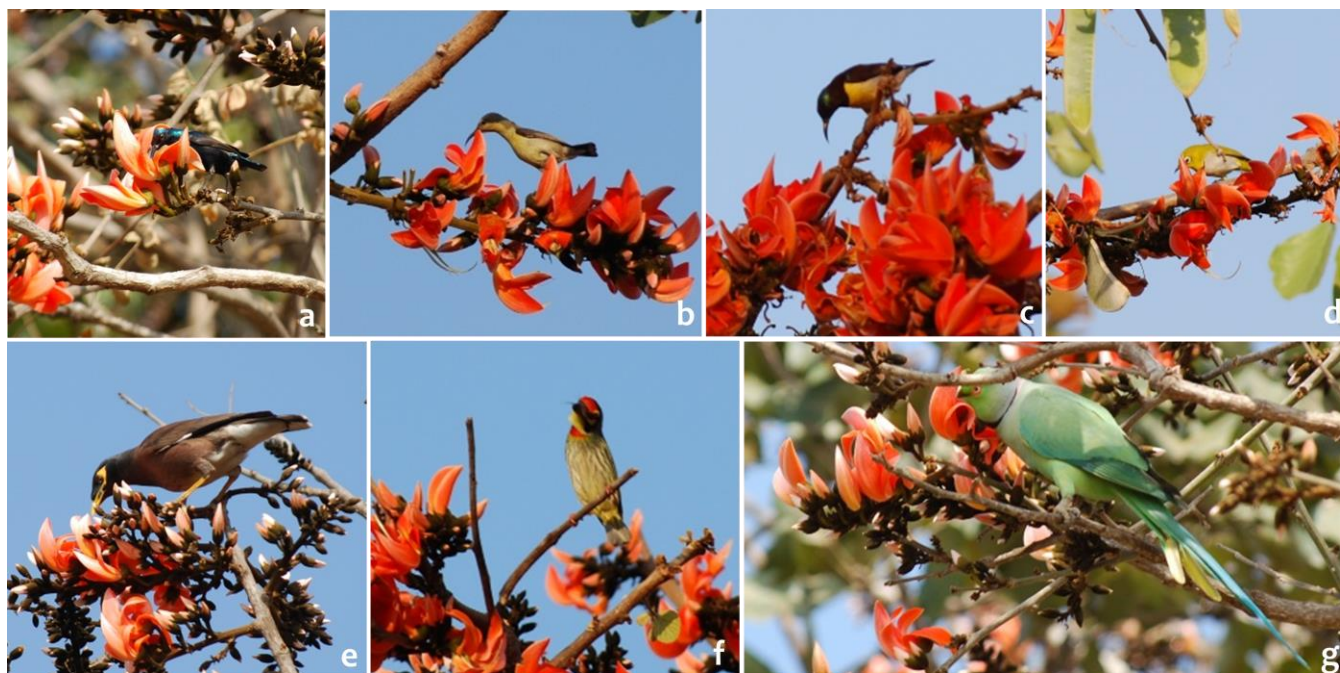
**Figure 1.** *Butea monosperma*: a. Flowering tree, b. Flowering inflorescence, c-g. Anthesis stages, h. & i. Position of stamens and stigma, j. & k. Diadelphous stamens, l. Pistil.

## 3. OBSERVATIONS AND DISCUSSION

*Butea monosperma* is a semi-deciduous tree species which flowers during dry season (Figure 1a). Leaf shedding occurs prior to the initiation of flowering phase. The inflorescence is a paniculate raceme consisting of more than 100 buds which mature without any definite order to define the flower arrangement either as acropetal or basipetal (Figure 1b). Mature buds open during 0600-0700 h (Figure 1c-g) and the flowers are weakly protandrous with anther dehiscence taking place in mature bud and stigma receptivity occurring at anthesis. The calyx is cup-like and 5-lobed apically. The corolla is typically papilionaceous with 1 broad standard petal, 2 wing petals and 2 keel petals; the standard petal is quite distinct as it stands separately from the other petals. All five petals are bright orange-red and impregnated both outside and inside with silvery silky hairs. The standard petal curves backward in synchrony with anthesis while wing and keel petals remain closed; the stamens are 10, diadelphous of which 9 are united as a



single bundle forming a long staminal tube while 1 stamen is free and placed below the level of united stamens; the anthers of all ten stamens are bi-lobed (Figure 1j-l). The ovary is unilocular, centrally seated and it is extended into a long style which is curved at the tip and terminated with a simple stigma (Figure 1h,i). The stigma is placed below the height of the stamens in maturing bud, grows quickly during mature bud stage and overtops the bundled stamens. The sex organs remain enclosed under tension inside the keel petals even after anthesis. Individual flowers secrete  $28.2 \pm 2.3 \mu\text{l}$  of nectar with 26-30% sugar concentration almost by the time the standard petal begins to unfold; the nectar is stationed around the ovary at the corolla base and it can be seen through the openings at the basal portion of the staminal tube. But, these staminal tube openings are completely concealed by the staminal tube even during open state of the flowers. There are no openings at the staminal tube base that runs parallel to the side of keel-wing petal complex. The flower life span is 2-3 days.



**Figure 2.** *Butea monosperma*: a. *Nectarinia asiatica* (male), b. *Nectarinia asiatica* (female), c. *Nectarinia zeylonica* (male), d. *Zosterops palpebrosa*, e. *Acridotheres tristis*, f. *Megalaima haemacephala*, g. *Psittacula krameri*.

Faegri and van der Pijl (1979) documented that the floral traits such as diurnal flower-opening, robust, odorless flowers with orange-red corolla, deep seated, concealed nectar and ovary, production of ample volume of nectar and the placement of stamens and stigma far away from the nectar location are the characteristics of bird-pollinated flowers. In this study, *B. monosperma* is found to display all these floral traits indicating that it is adapted for pollination by birds. Further, the flowers are partially erect in orientation and the birds initially need to learn how to access the concealed nectar. Our field observations indicated that *B. monosperma* is exclusively foraged for nectar regularly and consistently throughout the day by the passerine birds, *Nectarinia asiatica* (Figure 2a,b), *N. zeylonica* (Figure 2c), *Z. palpebrosa* (Figure 2d), *Acridotheres tristis* (Figure 2e), *Megalaima haemacephala* (Figure 2f) and the non-passerine bird, *Psittacula krameri* (Figure 2g). All passerine birds pay legitimate visits to the flowers to collect nectar. They probe the flowers mostly from the side of keel-wing petal complex and occasionally from the side of standard petal. They get easy access to nectar through openings in the basal part of the staminal tube only when they probe the flowers with the standard petal facing the their bill/beak during which this petal is lifted up and the other petal complex is pressed downwards; in this probing behaviour, the possibility of damage to any part of sex organs is totally ruled out. But, when these birds probe the flowers from the side of standard petal, they cannot get access to nectar as there are no openings at the basal portion of staminal tube and hence such visits become abortive. In both modes of flower-probing, the violent release of sex organs from the keel petals occurs ejecting the pollen from the anthers onto the ventral side of the bill/beak and forehead. As a result, pollination occurs. The nectar-feeding activity of the birds indicates that they act as pollinators. The non-passerine bird, *P. krameri* probes the flowers legitimately to consume nectar but its probing activity causes damage to the staminal column and even ovary; it also plucks flowers and eats the nectar-bearing parts of the corolla. Its flower-feeding activity indicates that it is not the pollinator and also shows negative effect on the reproductive success of the plant. Tandon et al. (2003) reported that *B. monosperma* is pollinated by *Nectarinia asiatica* and

*Funambulus tristriatus* because they consume nectar legitimately while other birds either simply perch without collecting nectar or collect nectar by making a hole in the calyx. Solomon Raju and Purnachandra Rao (2007) reported that *Butea superba* is pollinated by passerine birds, *Acridotheres tristis*, *Chloropsis aurifrons*, *Anthus richardi*, *Nectarinia asiatica*, *N. zeylonica* and the non-passerine bird, *Merops orientalis* while non-passerine birds, squirrels and monkeys cause damage or remove the flowers in quest of consuming the nectar or nectar-bearing portion of the corolla. Therefore, the present study shows that *B. monosperma* is typically bird-pollinated as there are no visits by insects; birds that act as pollinators are passerines only.

#### 4. CONCLUSION

*Butea monosperma* is a hermaphroditic, ornithophilous dry season blooming tree species. The flowers are typically large and papilionaceous with deeply seated and concealed nectar. The passerine birds utilize this nectar source legitimately by probing from the wing-keel petal complex side and act as exclusive pollinators. The non-passerine bird, *Psittacula krameri* is a nectar robber by causing damage to the staminal column and ovary which in turn shows it affects negatively on the success of sexual reproduction in this tree. Nevertheless, this tree is an important nectar source during dry season when there is a dearth of floral nectar for birds.

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#### Authors contributions:

All authors contributed equally.

#### Ethical approval

*Butea monosperma* tree was observed in the study from Andhra Pradesh. The ethical guidelines for plants & plant materials are followed in the study for collection & identification.

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This study has not received any external funding.

#### Conflicts of interests

The authors declare that there are no conflicts of interests.

#### Data and materials availability

All data associated with this study are present in the paper.

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